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PICTURES OF EGYPT'S FUTURE*

A Dynamic Analysis of Sectoral Development

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I. SUMMARY: Pictures of Egypt's Future

It is inevitable that the foresight and plans of policy makers should be shaped by past conditions which have formed their perceptions of reality. Yet it is imperative that new problems and new conditions be recognized and anticipated, if plans are to be successful in achieving development goals. Planning models may be regarded as presenting alternative pictures of the future and, if they are efficacious, the means of achieving the features envisioned. Multi-sector, multi-period programming models have been used in this manner in the applications to be described. Standing in the present, it is possible to discern many alternative futures depending on the outside forces which impinge and the domestic policies pursued. The systematic working through of many alternatives and the detailed demonstration of their implications is the task of a planning ministry and was not attempted in the project on which this paper is based. Three different scenarios are described below, none of them representing a single best guess as to Egypt's economic future. Together, however, they illustrate some of the major implications of current and future development problems and policies.

Development policy has typically concentrated on investment planning. Although this emphasis has been the subject of a considerable criticism, there are good reasons for such a focus. Capital is typically relatively scarce and new investment is often the carrier of technological change. Investment projects, moreover, are the means for organizing all factors into productive units. As a result investment may receive a disproportionate share of attention. However, in the analysis to be presented, labor and land use patterns in agriculture, as well as investment allocations, are analyzed for all sectors.

The first scenario, which the model is used to describe, is one for which land and labor are not constraining in any future period. The only limiting factors are foreign exchange and the initial capital stocks. Growth comes via use of these for current production and capital accumulation with labor and land supplies being completely accomodating. The purpose of this example is the calculation of what labor and land availabilities must be if they are not to constrain an otherwise plausible development program.

The next scenario is a projection made with reasonable limits set on land and labor availabilities, as well as foreign exchange and capital stocks, and under the assumption that recent patterns of foreign trade remain unchanged. This provides an illustration of growth via capital accumulation with realistic primary factor supplies and with no major revisions in sectoral orientations with respect to domestic and foreign sources of supply and markets.

The final example employs factor supply and foreign assistance conditions similar to the second scenario, but allows the optimizing processes of the model considerable freedom to choose whether to supply domestic requirements from domestic or foreign sources and whether to produce for domestic use or export.

The first scenario suggests that relatively optimistic but nonetheless plausible growth, constrained only by the requirements of capital accumulation and foreign exchange, would require far larger supplies of labor and land than justified by any reasonable expectation. It comes as no surprise to learn that land is, and will be, scarce in Egypt. But the imminent constraint of labor may be somewhat surprising in what has usually been thought of as a "labor-surplus" country suffering from an excessively high rate of population growth.

This first example also suggests the importance of technical change which increases the productivity of the primary factors since it cannot be expected that the increases in the supply of these factors will satisfy the needs of overall growth. The land requirements are so large in this scenario that even the most ambitious schemes for land reclamation will not meet them. This also raises the question as to whether the current schemes - or enlargements of them - would be justified at the relatively high costs typically associated with land reclamation.

The lesson of the second scenario emphasizes that, with realistic, perhaps even optimistic, estimates of primary factor supplies and foreign exchange availabilities, the future looks bleak if the current foreign trade orientations of the various sectors are maintained. Land and labor availabilities are so constraining that overall growth can do only slightly better than maintain the per capita average. Again, technological changes which increased the productivity of the constraining factors would certainly improve results, more or less *pari passu* with the rate of productivity improvement.

The final example allows adjustment of the orientation of major agricultural and industrial sectors to or away from foreign markets and also the potential substitution of foreign for domestic supplies of the output of these sectors. These opportunities are exploited to varying degrees. Exports from the agricultural sectors are reduced and imports of their products increase. The motive is to break the land bottlenecks in these sectors and also to release labor from lower to higher productivity uses. Exports of the industrial sectors also increase to make-up for the lower foreign exchange earnings of the agricultural sectors.

In the last, as in the previous scenarios, foreign exchange is not the most constraining factor when its supply from exports and foreign capital inflows is projected at plausible levels. This depends, of course, on the successful completion and introduction into production in a timely manner of new projects. That occurs quite effectively in the rarified atmosphere of the models. It remains a continuing problem in reality.

It is to be expected that labor should become an increasingly scarce resource in the course of Egyptian development. Increasing labor scarcity is the result of the less rapid growth of labor than of the capital and natural resource supplies. This must, finally, be the basis for growth in labor incomes. While there has been a considerable amount written about increases in wages having a discouraging effect on the domestic saving needed for growth, even in these writings it is not foreseen that wages should stagnate indefinitely. The results of the analysis presented here suggest that wage pressures from domestic development will begin sooner than may generally have been anticipated.

It may be noted in passing that there already were substantial increases in wages beginning in the mid-1970's. However, although domestic growth contributed to those pressures, the large scale emigration of Egyptian labor seems to have been the proximate and more important cause.

While labor scarcity has not been regarded as a characteristic feature of the Egyptian economy, every schoolboy and girl knows that land is scarce. What are the kinds of adjustments which will make land less constraining? The approach to this problem, which has been taken thus far, has been the direct one, of increasing land supply through reclamation schemes. An indirect approach of reducing the dependence on domestic agriculture both for export earnings and to supply consumption and intermediate inputs is an alternative approach and, perhaps, a less costly one.

The latter policy is also a means of releasing lower productivity labor to higher productivity employment in the industrial sectors and thus helping to relieve a growing labor scarcity.

Finally, it should be emphasized that these scenarios are not the end of the analysis necessary to come to a more definitive view on future economic policy. Further use of the models would be useful but detailed microeconomic studies of the various sectors now becomes even more essential.

The analysis does not take into consideration a number of important difficulties as well as important facilitating factors. All problems of management of the required transformations and of market penetration and reorientations are assumed away or handled with perfect efficiency by the optimization process. The rate of growth projected for oil exports represents an optimistic view of the outcome of future exploration and discovery of oil reserves. Not all experts concur in this view which is crucial for Egypt's future. It permits the extrapolation of substantial growth in foreign exchange earnings. If this view is not correct, major adjustments would have to be made in Egyptian growth strategy. On the other hand, no help is provided from technological changes which increase resource productivity. Both types of omissions stress the importance of these neglected factors.

Overall, one possible product of the above analyses may be a sense of optimism. On reflection it is surprising that reassurances are required that Egypt can grow and develop. The uneven and disappointing economic performance of the 1960's and early 1970's have conditioned current perceptions. Growth will not occur automatically even with more investment and clever overall policies. But the fact that there is a strong growth potential should provide encouragement for the undertaking of the more difficult institutional reorganizations which are necessary if that potential is to be fully realized.

II. Introduction

In the acceleration of its economic development process the Egyptian economy will necessarily pass through many different types of transformations. The patterns of intermediate and final demands, the relative resource scarcities and technologies used, the sources of supply, the economic rewards received and even the perceived goals of development can all be expected to change. These changes will be both causes and effects of the economic policies which are implemented.

Analyses are required for many different aspects of the economic system and at different levels of aggregation in order to understand the transformations and to match the kinds and the levels of policy actions which are necessary. It is possible by various devices to isolate some of the issues and formulate policies, not independently of the entire development process, but without taking into account explicitly all the interrelationships. There are, however, other overriding issues for which the interdependent relations within the economy are so essential that major mistakes can be made if they are ignored. It is for the analysis of these latter issues that the construction of economy-wide models is undertaken. This paper will present a multisector, multiperiod optimizing model which has been formulated to assist in examining policy issues in Egypt and describe some of the results obtained in applying the model.

While the model to be presented is on the existing frontiers of the development of such analytical methods, it is not beyond those boundaries. For this reason, and also because the intention is to focus on the economic content of the analysis rather than on the methodology, this paper will not dwell on the structure of the models. Nonetheless, since at least a general understanding of the approach is necessary to appreciate both the strengths and the weaknesses of the results, the next section will describe the model structure briefly. The following sections will concentrate on some of the insights which have been gained from the use of the model. It is in the nature of such models that there is almost no end to the applications to which they can be put. Nor is there an end to the modifications which can be made to the models to improve their ability to deal with particular issues. Therefore, this paper will not be an exhaustive treatment of all the questions which can usefully be investigated with this type of analytical tool. The focus here will be long term changes in major resource scarcities and sectoral adjustments to such changes, a set of issues whose analysis is suited to the scale at which the model has been implemented.

Based on their relative ease of formulation and manipulation, data collection and comprehensibility there is a presumption in favor of simple theories and partial or sectoral analyses. That presumption gives way when the issues to be analyzed have, as their essence, sectorally and temporally detailed and complex interactions. Some of the most fundamental aspects of development are of just this type. Perhaps the prime example is the change over time in the proportions in which resources are allocated among productive sectors. This has been the focus of the classic analyses of Fl'dman, in the context of the USSR, of Mahalanobis for India, of the debate of the 1950's in the development literature over "balanced" vs. "unbalanced" growth and the continuing controversy over export promotion vs. import substitution development strategies.

An especially important aspect of sectoral resource allocation is the distribution and employment of the labor force. Since, in developing countries, most of the labor force is in the agricultural sector, the rate of expansion of output in agriculture, compared with the productivity and rate of growth of the labor force in this sector, as well as shifts in domestic and foreign supplies of agricultural products will determine the amount of labor which can be drawn off to staff the expanding urban industrial and service sectors. The demands for labor in the urban sectors will, in turn, depend on urban sector output growth rates which are conditioned by their investment rates and foreign exchange requirements and availabilities. These, reflexively, are contingent on the patterns of agricultural expansion and exports and import patterns. In addition to these general development patterns a variety of specific government policies depend on the sectoral changes in labor demands and supplies: plans for education, labor mobility, housing and social services, training and technological change.

Development issues are sometimes analyzed in terms of static, steady-state or asymptotic growth characteristics on the grounds that these can be made to reflect "long-run" conditions. When static analyses are used to represent some indefinite future period, there is an implication either that preparation for the future can be postponed or that the path to the future presents no problems. These are also the implicit presumptions when steady-state, static or asymptotic conditions are used to represent some future reality. It is also sometimes thought that the long term planning is necessary only in order to prepare for decisions which will have to be made in the future. Properly speaking, that should be called, "preparing for future decisions." Long term planning should refer to the preparation of policies which take into account conditions which are expected to prevail over some period of time stretching into the future and which, thus, require present actions in order to begin to deal with these expected future conditions. Since all economic policy should be made with the expected future conditions and consequences of current actions in mind, the syllogism leads to the conclusion that all planning should be long term planning. The purpose of long term planning is to inform present decision making.

These considerations imply that the analytical tools for making development policy should be able to take into account future as well as present conditions and intertemporal relations. Simplifications will always be necessary but it is a mistake to make a virtue of the necessity.

Given the inevitable analytical simplifications and data limitations of all economic models, it is also desirable to repeat the warning that no single solution to a model should be regarded as providing a definitive insight or policy directive. Fundamentally the purpose of policy models is to generate alternatives and elucidate their consequences and, in this way, to provide an informed basis for the choices which have to be made.

II Description and Evaluation of the Model Structure

The model which will be used here for insights into Egyptian economic development is of a type which is now well-known in the planning literature though it has not previously been employed in the same manner.[1] It was, for a time, the object of intense development but it has attracted less attention in recent years for reasons which will be discussed after a brief literary description. A detailed presentation of the equations and the "tableau" of the model is contained in an Appendix.

The model has the mathematical structure of linear programming so that it optimizes a linear objective or criterion function subject to a number of production, resource and output-use constraints which are also linear. Certain types of non-linearities can be accommodated within the model's structure by linear approximations but this potential, which has been explored elsewhere, has not yet been embodied in the applications of this model.

The economy is divided into twelve producing sectors:

(1) Staple food
(2) Non-staple food
(3) Cotton
(4) Other agriculture
(5) Food processing industries
(6) Textile industries
(7) Other industries
(8) Construction
(9) Crude oil and products
(10) Transportation and communication
(11) Housing
(12) Other services

The objective function is the discounted sum of aggregate consumption over six future periods. This simple specification of a welfare aggregate function should not be interpreted as a lack of awareness or interest in other economic and non-economic goals of development but rather an aspect of tactics designed to make the results obtained most readily comprehensible. As will be noted, other development objectives will be imposed via constraints and can be used as criteria to assess the alternative paths which emerge in the model's solutions. For example, partly to reflect the real desire in developing countries for continuing growth and, partly, to avoid some of the worst features of the extreme conditions associated with solutions of linear programming models, aggregate consumption is required to grow over time at some specified minimum rate.

Production in each sector requires intermediate inputs as well as capital and labor. The agricultural sectors require land inputs as well. All Intermediate inputs are determined through an input-output coefficients matrix. Primary inputs are also required in fixed proportions to output in each sector with the proportions differing across sectors and by type of input. Thus no direct substitution possibilities in production are embodied in the model.

The final demands include investment, government and private consumption and exports. The government consumption and export components are specified exogenously for each sector and each period except that, in some versions to be presented, exports are determined endogenously. The deliveries by each sector for consumption purposes in each period are related by a linear function to the period's aggregate consumption, determined as part of the objective function. The deliveries for investment purposes are also determined endogenously as part of the optimization process in order to provide the capital necessary to produce the desired output. Inventory investment is related to fixed investment by fixed coefficients. Imports in the model are of two types: "competitive" and "noncompetitive". The latter are related in different, fixed proportions to output in each sector and the former are determined endogenously up to some maximum limits for each sector. Total imports are constrained to be no more than total exports plus some stipulated foreign capital inflows.

Fixed capital accumulates in each sector through investment and depreciates "radioactively" in fixed proportions. The inputs required from the capital forming sectors to create capital in each sector are specified by a capital coefficients matrix. The supplies of land and labor are both exogenous to the model solution but, for each, a growth in effective availabilities over time is stipulated. This growth may be interpreted to include factor augmentation through growth in productivity as the result of technological change occurring over time.

A fundamental constraint requires that the total uses in each period of a particular sectors output, as an intermediate input or to satisfy final demands, must be less than or equal to total availabilities, as determined by domestic output and competitive imports.

Much of the data which are embodied in the model has been estimated from empirical information which is available for Egypt. However, some of the data are no more than informed guesses based on a general appreciation of conditions in Egypt and estimates or guesses which have been made from analogous data in other countries. Yet it would be mistaken to apologize too much for the quality of the data utilized. Whatever relevant data are available in Egypt have been used and special studies have been undertaken which have improved the quality of existing information and generated new data not previously available.

As is characteristic of such sectorally and temporally detailed models, they seem to require much more information than simpler, more aggregated and static approaches to planning. Yet in fact, there is no magic in aggregation which permits an escape from requirements for detailed information. Aggregation is justified only by the implicit assumption that the sectoral composition of the aggregate remains unchanged as a result of the economic processes examined. That, in turn, requires that the production and demand conditions are the same for all sectors and change in ways which maintain the sectoral proportions or that the differences are small or, if large, that they are exactly offsetting. These assumptions are not only generally unwarranted but precisely the opposite of what is both intended and expected in the course of development.

It has often been tempting to describe the solutions to the model as a social welfare optimum. That characterization gives too much credibility to both the model and the data. It is more useful and more accurate to consider each solution as the result of detailed calculations of the implications of particular types of growth. These are calculations which often can not be made with the same degree of success or in similar detail by a mathematical, non-optimizing structure. Although there is a choice of alternative mathematical optimization techniques, the only rival approach is a variation of a dynamic Leontieff model which is "almost consistent."[2] In principle, that might approach, through successive interations, what the optimizing model can produce in a single solution. Comparison of computational costs is difficult, for neither type of model is intended to be used to generate a single solution but rather to explore the space of feasible resource allocations and demonstrate the implications of alternatives. Other approaches which attempt to make the same type of disaggregated but interdependent calculations have unavoidable mathematical characteristics which produce economically unacceptable results. In effect, they generate negative inputs or outputs and or require adjustments in resources which are not plausible. Even the "almost consistent" models use particular sectors or sources of inputs as residual adjustment with no control over their plausibility.

Considered as a computational device to avoid such mathematical problems, the optimizing model is simply a way of mapping the implications of alternative policies and data specifications. It does this at the cost of the limitation to linear relationships. Non-linear optimization is feasible but not now as convenient computationally. Yet the avoidance through linear optimization procedures of one set of undesirable mathematical outcomes generates other undesirable features. The linearity of the model implies that every solution is an "extreme point." That is because, if it is optimal to move a little bit along a linear relationship, it will be optimal to move to the permissible limit, since the linearity means that the trade-offs of benefits and costs all remain constant up to the limit or "corner." By comparison, when there are essential non-linearities it is possible, even likely, that an optimum will be attained somewhere along some curved hypersurface, rather than at a corner.

In some dimensions, that is, with respect to some economic variables, the corner positions will be economically plausible, but in other dimensions that will not be the case. To avoid such undersirable and unrealistic results, solutions of linear models must be constrained to consist only of the set of plausible or desirable corners. This type of constraint may be regarded as reflecting the same kind of preferences as are embodied in the objective function. Yet, preferences embodied in a constraint have an absolute character that is not ordinarily a feature of the preferences included in an objective function where they can be substituted to a greater or less degree for other goals. As a consequence, preferences stated as constraints may lead to undesirable results. For example, as noted above, in order to avoid the extreme concentrations of consumption in a few periods, which might result from unconstrained linear optimization, a constraint is imposed that consumption grow at some minimum rates through the plan period. Suppose, however, that some particular type of resource whose availability is exogenously specified, say land, will become relatively scarce in future periods. Then it will be difficult in those periods to maintain growth rates achieved in earlier periods. Faced with this outcome, the constrained optimization process may opt to keep consumption at relatively low levels all during a plan period in order to meet a forced growth rate requirement.

Such attributes of linear optimization models are often considered to be rather annoying limitations of the mathematical structure. However, they also force the user to consider the full implications of a future constraint on growth, such as limited land availabilities. The more conventional approach, which is embodied in the "almost consistent" models mentioned above, is simply to extrapolate growth and to calculate the implied factor requirements in each period, admitting finally in some future period that factor availabilities will not support the projected output levels. This approach, however, neither recognizes the possibility of - nor makes - the adjustments that could be expected to take place in advance of the time in which in the growth is stopped by inadequacy of a factor. While not fully satisfactory in dealing with such problems, the optimizing model will not permit them to be overlooked.

The mathematical optimization process should be viewed primarily as a device for avoiding otherwise implausible and undesirable mathematical and economic results, rather than as generating a "true" social welfare optimum. Nonetheless, the solution does have some important "optimal" properties which should be considered seriously in evaluating the results. In some ways these optimal properties may be misleading with respect to what can realistically be expected from an economy. In order to achieve an optimum, some inputs may undergo drastic shifts from one sector to another. All the allocations are made with precisely the correct timing and in just the right amounts and with the perfect certainty that comes from surveillance over the entire planning period. In fact, of course, not only is perfect foresight lacking but there are political, technical and administrative difficulties which prevent the frictionless movement of resources and goods, especially when there are substantial changes in the patterns of flows. If the characteristics or at least the effects of the frictions were known, they could be modelled and

and added to the structure of the model. Unfortunately that is not the case. Yet, this important type of knowledge is no more lacking for these linear optimization models as for other approaches to planning. It might be argued with some merit that simple extrapolation of existing patterns would take the effects of frictions into account, at least as they existed in the past. Yet the disadvantage of extrapolation is that, in the course of accelerated development, it is particularly expected that past patterns will change.

With respect to the criticism of perfect foresight, which is implied in the model, that reflects an inadequate understanding both of the proper use of the model and, more essentially, of the manner in which policy should be made. It should never be expected that the time path generated by any policy making process will be followed faithfully to its ultimate end. For each period, policies should be made which reflect, as well as possible, the assessment of current and future conditions. Then, at the next opportunity to make policy, for example at the preparation of the next current and investment expenditures budget, there should be a new assessment of both current and future conditions and a new multiperiod policy formulated. Of course, in each formulation of policy the constraints and conditions generated by the actions of the previous period, e.g. the new investment projects which have been undertaken, must be taken into account.

Considered in this manner, the use of intertemporal models require no more foresight than any other approach to policy making. They do require more explicit statement of expectations as to the future. However they are quite "realistic" in the sense that those assessments which are made about the future are always taken into account.

While the optimizing feature of the models should not, as noted, be taken too literally, its necessary presence does emphasize an essential feature of policy modeling. That is the recognition of the inevitable necessity of making policy choices, in this model among alternative patterns of resource allocations and uses within each period and over time. These also imply choices with respect to the time pattern of consumption and investment.

Evaluation of the usefulness of multiperiod, linear programming models

There are at least two major works of evaluation of multiperiod, linear programming models both of which have a somewhat skeptical note. Skepticism about every type of policy-making framework is always warranted because all, including the most "practical" and "pragmatic", involve abstraction from reality. The danger exists, and seems always to a pressing one, that the particular set of abstractions are critical for the results obtained and policies recommended. The special skepticism about models such as those used here may be a reaction to what the models seem to claim, and what, in the past at least, was claimed for them. To find a "social optimum" extending over a planning horizon, which seems to be what the model claims for itself, must be the ultimate goal of all policy-makers. In the face of this apparent contention, skepticism would surely be warranted. The models are vulnerable at many points, for example: the simple welfare functions, the thorough-going linearity, the assumed exogeneity of many endogenous relations, the lack of price responsiveness and the lack of an integrated monetary sector. How can comprehensiveness and optimality be claimed for an analytical approach with such limitations. The more limited contention offered above, that the analytical structure is only a more convenient and appropriate mathematical structure, has seldom been made and, therefore, seldom appreciated. If the multiperiod, optimizing analytical structure is understood in this way, the manner in which the models should be evaluated and used becomes familiar. They are simply mechanisms which can be employed to explore alternatives. They have the benefits of achieving full consistency among all the elements they embody and costs of simplications and omissions which are analogous to, but different in degree and kind, from those of other models.

Perhaps another source of skepticism and neglect of such models has been their lack of practical use. They have been developed for a number of countries in conjunction with responsible policy making and yet have not become established institutionally and have not contributed regularly to policy formulation. That may reflect a fundamental weakness or difficulty in using these models. In fact, with only a few exceptions, the same can be said about all relatively sophisticated economic policy models for developing countries. There are very few analytical frameworks which are used in a regular and continuous manner in any country and there are special explanations for those which are used.

Some of the methods of cost-benefit analysis for project analysis constitute an important exception to the last generalization. This reflects the recognition in developing countries of a real need which the analysis satisfies. Perhaps, an even better explanation is that the use of this analysis reflects the demands of national and international assistance agencies. That the results can be neglected, even when readily available and, sometimes, even when applied, is suggested by the many "horror stories" which circulate of unwise and socially unprofitable undertakings.

Other analytical approaches to economic policy used widely in or for developing countries are the macroeconomic models of the IMF and the IBRD. Neither are regarded by their progenitors nor their subjects as means of making long-term development policy but rather as instruments for diagnosis of short term problems and, perhaps, guides to prescriptions for their remedy.

For guidance with respect to policies related to sectoral development it seems fair to say that current usage relies on sectoral studies. These are microeconomic studies though, perhaps, with some attempt at integration into a overall framework. The attempt cannot be very ambitious because it would then become a general equilibrium approach.

Explicit general equilibrium models have been developed and become popular among development model builders in recent years. They are useful in analyses of a variety of policy problems but they cannot easily be made dynamic and given a substantial degree of sectoral and factor detail. It is, moreover, an open question as to whether fewer crimes are committed in preparing the data for these models than for the multi-period, multi-sector optimizing models.

The general equilibrium models embody a number of explicit policy tools, particularly tax and subsidy rates, as well as exogenous specification of sectorally detailed government expenditures and investments. This is one of the attractive features of these models. By comparison, the question has been raised as to what policy tools are embodied in the multi-period, multi-sector optimizing models. The models are typically, but not necessarily, too aggregate to be helpful in decision-making about particular projects. And, it may be asked, what government or private body makes decisions about the sectoral allocation of investment, an issue on which the latter models do throw light. Investment decisions, it may be argued, are made on particular projects, not on sectors.

Yet critical types of resource allocation decisions are made for sectors. In those countries in which government plays a major investment role, the investment budget is allocated among sectoral ministries and authorities with the next step being its commitment to particular projects. In some cases the sectoral budget requests are the sum of project requirements, but there are few who would be so sanguine as to argue that such requests always reflect consistent ranking of projects in all ministries by some consistent and efficacious benefit-cost analysis. Thus, there is no project-based method of insuring overall consistency of the projects among themselves and with national development objectives. It is this consistency which the models used here provide.

The sectoral allocation of investment is still one of the great and central issues of development policy. Retreat from multisector, multiperiod models leaves a void which has been filled by attempted generalization of case studies. However, while formal multi-sector, multi-period models can improve in some important ways on a static and partial equilibrium approach, it must be emphasized that they are not the end of economic policy-making, but only a good beginning.

III Resource Requirements and Allocations for Egyptian Development

The particular application of the model on which this section will focus is one of the grand issues of development: what should be the allocation of resources among the various sectors, taking into account import requirements and export potentials, resource requirements and resource availabilities. It might be objected that this is not a question of practical policy like whether or not a subway or a textile plant should be built or larger or smaller consumer subsidies provided. But this is a fundamental problem which has preoccupied several generations of development economists and whose answers, in turn, have become the basis for resolving the questions which require practical decisions.

There is no single "correct" strategy to deal with the issues of sectoral resource allocation and trade policy. The decisions made reflect social preferences as well as technical, economic and behavioral constraints. And, of course, one of the prior set of questions is the precise nature of these constraints. It often turns out that the latter questions are the source of many disagreements. One of the virtues -or weaknesses, depending on the point of view- of the models is that they require an explicit statement of the constraints. However, the implications of the various specifications are likely to have more meaning if they are described in the course of presenting the solution results. Then the reader can participate in the discovery of the reasons for the particular results, perhaps finding some that the authors have not, themselves, discovered.

1. Scenario A: No supply constraints or primary factors

The first solution to be presented is one in which the only "resource" constraints are capital stock and foreign exchange. It is assumed that there are fixed ratios between capital inputs and outputs which are different in each sector. Of course it takes time (three years) and the outputs of the various capital forming sectors to create capital, with the composition of the latter also varying among sectors. Imports are required for the outputs of all sectors except Housing and Construction, again in proportions which vary among sectors, and can also, up to some limits, substitute for domestic output in all except these two sectors.

It is reasonable to begin with only capital and foreign exchange constraints as they have often been considered the most pressing limitations on development in Egypt where labor abundance and even redundance has been a widely accepted characterization. Arable land, though dramatically limited to the immediate Nile basin, produces outputs for which there are good foreign substitutes in any case. As will be seen, the labor and land supplies which have to be available so that these two factors do not become constraining will also be calculated.

Table 1 presents the national income accounts which are generated in the solution. The results embodied in these accounts are somewhat "optimistic" judging by past accomplishments but are close to some plan targets and are not wholly implausible. They do show some of the unlikely features of linear programming models which do not have diminishing returns or absorptive capacity constraints built into them. These results are manifest in the tendency to concentrate the largest increases in consumption toward the end of the planning period. The "boundary effects" of the terminal conditions are also apparent in the slowing of the general growth in the last period. The terminal conditions are never fully successful in accomplishing the task of inserting, without distortion, the indefinate future into a truncated planning period.

In describing the results and their implications comparisons will be made within the plan period since the first period also tends to reflect the special problems of transition from past endowments to future investment patterns. However, as will be seen, the transition problems were reduced in this case by adjusting initial capital stocks and capital productivities so that unused capacities were 10 percent or less in every sector.[3] The average gross national product in the first three year period in the solution, at MLE 6548 compares with a GNP of MLE 6647 in 1976, the immediate preplan year which provided the data base for the model, indicating a reasonable correspondence of the model solutions with reality.

The annual average growth rate of GNP generated in the model solution over the plan period, starting from the first period is 7.6 percent; from the first to the next to the last period it is 9.1 percent. As noted these rates are not too different from those projected in recent Egyptian plans. The growth rates of consumption over the same periods are 8.9 percent and

Table 1

Scenario A: No supply constraints on primary factors

NATIONAL INCOME ACCOUNTS

PERIOD	1	2	3	4	5	6
SECTORS						
PRIVATE CONSUMPTION	12581.7695	13656.8705	18553.2481	30512.5754	42589.7419	45860.6488
INVENTORIES CHANGE	466.8527	736.3962	1100.6605	1025.5998	717.6688	428.4260
FIXED INVESTMENT	3717.1958	7230.2267	11580.6411	10972.7532	7502.2874	5530.2839
TOTAL INVESTMENTS	4184.0485	7966.6229	12681.3016	11998.3530	8219.9562	5958.7098
GOVERNMENT EXPENDITURES	5208.0000	6202.8113	7387.5481	8798.5697	10479.0963	12480.6035
EXPORTS	3147.0000	3539.9470	3981.7314	4478.6504	5037.5848	5666.2740
IMPORTS	5298.7879	6425.8108	7946.8441	9172.3576	10304.6223	11608.1402
GNP	19645.0404	24940.4413	34631.8117	46576.3496	55979.5420	59205.3495
AGGREGATE CONSUMPTION/GNP	0.9107	0.7963	0.7490	0.8440	0.9480	0.9854
INVESTMENT/GNP	0.2130	0.3194	0.3662	0.2576	0.1468	0.1006

10.6 percent respectively, which are rather higher than projected. As can be seen in Table 1, the domestic savings rates are also relatively high by historical standards. That is why the proportionate contribution of the foreign savings though large in absolute terms is less during the plan than the pre-plan period.

It may be asked how the model solutions can generate both higher domestic savings rates and higher consumption growth rates than have heretofore been achieved. The answer is in the efficiency in allocating and using resources which is part of the model solution.

The character of the growth patterns embodied in this solution is perhaps, shown most clearly in the investment allocations and capital stock utilization it projects. The former are shown in Table 2 in which the fixed investment in each sector in each period is listed. It will be observed that there is no investment in some sectors in some periods. This reflects several aspects of the model solution. First, the linearity of all the relations means that, if one type of allocation dominates another at any point, it will dominate up to a discontinuity, when some other allocation becomes more desirable. Second, the optimizing process is a "fine tuning" procedure which will pick out the extreme position and switch to it without hesitation as there are no adjustment costs. Finally, the allocations in the first and last periods also reflect adjustments to initial and terminal conditions which, for different reasons, are not fully consistent with the allocation patterns desired during the plan period. For these reasons the total investment in each sector and the sectoral proportions in which investment is allocated among the sectors over the entire plan period are presented as more enlightening than the percentages for any single period. These are presented in column (7).

All of agriculture receives about 25 percent of fixed investment.

Table 2

Scenario A: No supply constraints on primary factors

Investment by Destination

Period	1	2	3	4	5	6	Total Amount	Total Percent
Receiving Sectors								
Staple Food	232.7982	239.0339	433.9604	390.5618	267.0202	508.8274	2072.2469	4.6
Non-Staple Food	207.2316	874.9643	1692.7612	1619.6901	735.8790	1621.7299	6752.2561	14.9
Cotton	37.5623	115.3109	155.2365	166.2666	94.6344	208.9015	777.9122	1.7
Other Agriculture	56.4590	345.3362	577.7214	546.7385	264.0437	516.7148	2307.0136	5.1
Food Processing & Industry	23.2846	369.3761	740.9930	666.9460	856.4989	0.0	1523.4443	3.3
Textile Industry	71.5842	0.0	473.8812	539.0885	1667.2393	0.0	2751.7572	6.1
Other Industries	1728.6412	1847.1996	2422.2828	2287.6090	0.0	0.0	8285.7326	18.3
Construction	379.5550	495.0168	0.0	0.0	0.0	0.0	874.5718	1.9
Crude Oil & Products	375.2358	623.0707	840.9014	620.4322	899.1437	0.0	3358.7838	7.4
Transports & Communication	143.5725	522.3347	1094.5757	1128.9915	1439.3301	11.0077	4339.8122	9.6
Housing	53.4715	965.9520	2334.0952	2429.9341	704.3269	1677.1292	8164.9089	18.0
Other Services	407.8000	832.6313	814.2324	576.4951	574.1711	985.9734	4191.3033	9.2

About 25 percent goes to industrial investment excluding petroleum and products. The largest of the remaining proportions is the 17.5 percent of total fixed investment directed to housing.

The levels and ulilizations of the capital stock are shown in Table 3. The "slack" is the amount of capital stock which is not utilized. It will be noticed immediately that, in the first period, it is only in the construction sector that the capital stock is fully utilized. This provides important insights with respect to the requirements of economic growth as well as resulting in part from several features of the model. The linearity of the relationships in the model and lack of substitution possibilities both in consumption and production mean that, if the capital stocks endowed by the past to the first plan period, do not exactly match demands, there will be some underutilization of the endowments. The insight into the economy comes appreciating that the patterns of capacities desired for the growth projected in the model solution are different from those which existed at the beginning of the plan period. This should not come as a surprise. Development implies changes in the relative importance of the various sectors. This change is shown in a rather discontinuous manner in the solution due to the structure of the model.

It should be noticed, however, that nearly all of the excess capacities are less than ten percent and, in some sectors, such as Other Industry, and Crude Oil and Products, they are virtually negligible. Further, after the first period the capital stock in each sector is nearly always fully utilized, except in the final period, reflecting again the particular burden, or mis-match, of the terminal conditions. Essentially, in the first period, the solution tries its best to break a construction capacity bottleneck in order to proceed with investment at a rapid rate. That is a plausible result which finds a chord of response in actuality. Construction has been a bottleneck

Table 3

Scenario A: No supply constraints on primary factors

FACTOR AVAILABILITIES & USAGE

CAPITAL STOCK

PERIOD	1		2		3		4		5		6	
TYPE	STOCK	SLACK	STOCK	SLACK	STOCK	SLACK	STOCK	SLACK	STOCK	SLACK	STOCK	SLACK
SECTORS												
STAPLE FOOD	720.	49.	938.	0.	1154.	0.	1559.	0.	1910.	0.	2130.	0.
NON-STAPLE FOOD	2113.	100.	2271.	0.	3089.	0.	4705.	0.	6207.	0.	6788.	0.
COTTON	374.	20.	402.	0.	507.	0.	650.	0.	800.	0.	874.	0.
OTHER AGRICULTURE	765.	85.	803.	0.	1128.	0.	1678.	0.	2182.	0.	2392.	0.
FOOD PROCESSING & INDUSTRY	913.	92.	914.	0.	1260.	0.	1970.	0.	2587.	0.	3379.	613.
TEXTILE INDUSTRY	797.	36.	848.	0.	827.	10.	1280.	0.	1787.	0.	3410.	1549.
OTHER INDUSTRIES	5554.	60.	7144.	0.	8812.	0.	11014.	0.	13027.	0.	12701.	3164.
CONSTRUCTION	309.	0.	690.	0.	1168.	0.	1139.	0.	1110.	388.	1083.	196.
CRUDE OIL & PRODUCTS	1516.	33.	1854.	0.	2430.	0.	3211.	0.	3751.	0.	4556.	826.
TRANSPORTS & COMMUNICATION	1275.	43.	1387.	0.	1874.	0.	2922.	0.	3978.	0.	5316.	955.
HOUSING	1731.	140.	1744.	0.	2667.	0.	4934.	0.	7241.	0.	7764.	0.
OTHER SERVICES	1718.	124.	2083.	0.	2864.	0.	3606.	0.	4093.	0.	4564.	0.

sector in the second half of the decades of the 1970's.[4] Yet this insight was not imposed on the model but discovered by it and, in the solution, resources are mobilized to break the bottleneck.

Shadow prices on the various constraints are shown in Tables 4 and 5. They indicate the contribution to the objective function of a one unit relazation of each constraint. The capital constraint limits output to the capacity of the capital stock. The import constraint limits the amount of "competitive" imports allowed to each sector. The consumption growth constraint forces a minimum growth rate and the foreign exchange constraint limits imports to the total foreign exchange available.

Capital stocks are the binding constraint on growth for most of the plan period, as indicated by the higher shadow prices on these stocks than on any other constraint. Moreover, the domestic capital stocks necessary to produce and create more capital are the most binding constraint for most of the plan period as indicated by the fact that their shadow prices are higher than the shadow price on foreign exchange until the last several periods.

It is instructive to turn next to the requirements for labor and land which are implied in this solution. Table 6 shows the sectoral and total labor employment in each period and Table 7 presents the total land requirements and the distribution of land in producing the crops of the various agricultural sectors. In the first period the required labor would leave a 5.7 percent unemployment rate in a labor force of 10 million workers. After the first period the labor requirements grow at the rate of 8 percent to the last period and at the rate of 9.2 percent to the next to the last period. These are quite high rates and must generate skepticism that the GNP growth rates, with which they are consistent can be achieved.

All the calculations are made with constant labor productivities.

Table 4

Scenario A: No supply constraints on primary factors

SHADOW RENTALS ON CAPITAL CONSTRAINTS

PERIOD	1	2	3	4	5	6
SECTORS						
STAPLE FOOD	.	3.68234-	.82567-	.39903-	.14181-	.00220
NON-STAPLE FOOD	.	3.68360-	.82646-	.39831-	.14200-	.00275
COTTON	.	3.74086-	.78361-	.38875-	.13720-	.00523
OTHER AGRICULTURE	.	3.76658-	.76724-	.38493-	.13401-	.00787
FOOD PROCESSING & INDUSTRY	.	1.64086-	.72934-	.35326-	.17406-	.
TEXTILE INDUSTRY	.	2.41061-	.	.32563-	.16360-	.
OTHER INDUSTRIES	.	1.53323-	.75825-	.38367-	.29480-	.
CONSTRUCTION	47.81411-	1.54994-	2.21672-	.07743-	.	.
CRUDE OIL & PRODUCTS	.	.79411-	.68200-	.36825-	.19678-	.
TRANSPORTS & COMMUNICATION	.	3.15873-	.57767-	.34617-	.12542-	.
HOUSING	.	6.29222-	.43781-	.37479-	.07778-	.06592
OTHER SERVICES	.	4.05603-	.53698-	.35413-	.11158-	.01912

Table 5

Scenario A: No supply constraints on primary factors

Shadow Price on Import Constraints

PERIOD	1	2	3	4	5	6 ...
SECTORS						
STAPLE FOOD	0.00169	2.46125	0.02742	0.0	0.0	0.0
NON-STAPLE FOOD	0.00939	2.46052	0.02129	0.0	0.0	0.0
COTTON	0.00721	2.06675	0.0	0.0	0.0	0.0
OTHER AGRICULTURE	0.00038	1.88391	0.0	0.0	0.0	0.0
FOOD PROCESSING & INDUSTRY	0.00646	1.18218	0.0	0.0	0.0	0.0
TEXTILE INDUSTRY	0.02931	1.59873	0.0	0.0	0.0	0.0
OTHER INDUSTRIES	0.00612	1.91775	0.55677	0.0	0.0	0.23721
CONSTRUCTION	0.0	0.0	0.0	0.0	0.0	0.0
CRUDE OIL & PRODUCTS	0.03978	0.87071	0.28242	0.0	0.0	0.20949
TRANSPORTS & COMMUNICATION	0.0	0.0	0.0	0.0	0.0	0.0
HOUSING	0.0	0.0	0.0	0.0	0.0	0.0
OTHER SERVICES	0.0	0.0	0.0	0.0	0.0	0.0

SHADOW PRICE ON CONSUMPTION GROWTH CONSTRAINTS

PERIOD	1	2	3	4	5	6 ...
SH. PRICE						
	1.22930-	2.02163-	.	.	.	.08977

SHADOW PRICE OF FOREIGN EXCHANGE CONSTRAINTS

PERIOD	1	2	3	4	5	6
SH. PRICE						
	.	.	.59272-	.84102-	.64271-	.53633

Table 6

Scenario A: No supply constraints on primary factors

FACTOR AVAILABILITIES & USAGE

LABOUR AVAILABILITIES
& UNEMPLOYMENT

PERIOD	1	2	3	4	5	6
SECTORS						
STAPLE FOOD	0.7004	0.9789	1.2270	1.6578	2.0317	2.2649
NON-STAPLE FOOD	1.9214	2.1684	3.0063	4.5783	6.0400	6.6050
COTTON	0.4556	0.5179	0.6661	0.8533	1.0504	1.1484
OTHER AGRICULTURE	1.0235	1.2092	1.6990	2.5266	3.2868	3.6023
FOOD PROCESSING & INDUSTRY	0.5463	0.6076	0.8380	1.3098	1.7206	1.8396
TEXTILE INDUSTRY	0.3953	0.4411	0.6369	0.9985	1.3941	1.4515
OTHER INDUSTRIES	0.1611	0.2095	0.2817	0.3521	0.4164	0.3049
CONSTRUCTION	0.4177	0.9341	1.5806	1.5411	0.9769	1.1993
CRUDE OIL & PRODUCTS	0.0161	0.0201	0.0264	0.0348	0.0407	0.0404
TRANSPORTS & COMMUNICATION	0.4468	0.5029	0.6798	1.0598	1.4428	1.5823
HOUSING	0.1601	0.1755	0.2683	0.4964	0.7284	0.7811
OTHER SERVICES	3.2069	4.1910	5.7615	7.2557	8.2342	9.1835
TOTAL EMPLOYMENT	9.4271	11.9291	16.6346	22.6079	27.2886	29.9229

Table 7

Scenario A: No supply constraints on primary factors

Land Usage

LAND

PERIOD	1	2	3	4	5	6
SECTORS						
STAPLE FOOD	5.0158	7.0096	8.7862	11.8713	14.5488	16.2185
NON-STAPLE FOOD	2.5061	2.8234	3.9213	5.9717	7.8782	8.6153
COTTON	1.2274	1.3952	1.7945	2.2989	2.8298	3.0939
OTHER AGRICULTURE	3.1262	3.6934	5.1896	7.7174	10.0395	11.0031
TOTAL USAGE	11.8754	14.9267	19.6915	27.8594	35.2962	36.9308

So the projected requirements may be satisfied by both labor force growth and growth in labor productivity. A reasonable projection for annual labor force growth is, say 2.2 percent per year. The rest of the effective labor growth must be based on productivity improvements, if overall growth is not to become labor constrained. It should be noted that even if there is substantial overall unemployment or underutilization of labor, the absorption of this labor into fully productive enterprise only slightly postpones the date at which labor becomes constraining.

The implications of these results is that the conventional image of Egypt as "drowning in its population" will soon change if reasonably high growth can be achieved. When full employment is achieved, annual productivity increases of 5.8 percent to 7.0 percent will be required if high overall growth is to be maintained. This raises the question as to whether and how that could be feasible.

It may seem that there is nothing in the reasoning which would have required a sophisticated model. It is simple arithmetic that, if overall growth is to be at rates of 8 or 9 percent, with a labor force growth rate of only 2.2 percent, labor productivity must increase. Similar arithmetic applies for all developing countries. Only the strategies of relaxing the constraint differ. Yet the sectoral detail provided in the model improves on the aggregate calculations because it takes into account the differences in sectoral growth rates over time and the differences in sectoral requirements for labor. One striking result is that, by the end of the plan period in this solution, the proportion of the employed labor force in agriculture will have grown slightly, from 43.5 percent to 45.5 percent. It should be recalled that no provision was made in the model for technical change in agriculture, which would increase labor productivity, or for changes in the patterns of exports or domestic consumption which might reduce demands for domestic agricultural production. The simple extrapolation of those demands and more particularly the increase in domestic consumption of agriculture products induced by the rapid increase in income generates the increase in labor requirements in agriculture. By comparison, the industrial labor force grows hardly at all, as a proportion of the total labor force, in this solution, staying close to 12 percent. Thus, the solution represents growth without transformation of the economy, a pattern which was not imposed but which emerges from the analytic processes inherent in the solution.

The amount of land required in the solution increases by 225 percent from the first to the last period. The average annual rate of growth of land requirements implicit in Table 7, from the first period to the last, is 8.2 percent; from the first to the fifth period it is 9.5 percent. As in the case of labor, these growth rates could be satisfied either by increases in land productivities in the various sectors or by land reclamation. There, are in fact, plans for increases cropped area through the reclamation and irrigation of desert lands. Against that has to be set the losses of land to cultivation because of water-logging. The latter can also be offset by drainage and reclamation. Projects for the creation of new farming lands and for drainage of existing land are well underway in spite of their relatively high cost. Nonetheless, it would be difficult to believe that even the most ambitious of these plans will generate as much, or more, than, say, a 25 percent increase in cropped area over the projected period, which would be a 1.5 percent average annual increase. Thus a 7 to 8 percent average annual increase in land productivity would be necessary to satisfy the land requirements which are generated by the model solution. It appears again but, perhaps, less surprisingly for this factor, that limits to the availability of a primary resource will be a constraining influence on Egyptian growth unless explicit and efficacious steps are taken to avoid this bottleneck.

Table 8

Scenario A: No supply constraints on primary factors

Gross Output By Sector. (Mill LE)

PERIOD SECTORS	1	2	3	4	5	6
STAPLE FOOD	1256.60758	1770.10991	2218.72735	2997.79841	3673.93389	4095.58610
NON-STAPLE FOOD	3797.18666	4285.47490	5941.31450	9048.09195	11936.67858	13053.41380
COTTON	667.04584	758.24972	975.26242	1249.41271	1537.92086	1681.46213
OTHER AGRICULTURE	1359.19728	1605.83802	2256.36456	3355.39825	4364.99028	4783.95308
FOOD PROCESSING & INDUSTRY	4107.76542	4568.27341	6300.94719	9848.38871	12936.90934	13831.72191
TEXTILE INDUSTRY	2533.72790	2827.28043	4082.51859	6400.93158	8936.35110	9304.47539
OTHER INDUSTRIES	4131.24748	5371.33202	7223.33786	9028.23180	10677.61514	7817.61906
CONSTRUCTION	1848.11976	4133.08376	6993.92948	6819.08139	4322.73375	5306.68959
CRUDE OIL & PRODUCTS	1787.21885	2233.41665	2928.26887	3868.19640	4519.00023	4493.72586
TRANSPORTS & COMMUNICATION	1838.52631	2069.69020	2797.55198	4361.30830	5937.33751	6511.38680
HOUSING	477.82979	523.80827	800.78878	1481.69857	2174.36609	2331.51657
OTHER SERVICES	9544.23103	12473.35308	17147.33593	21594.29628	24506.50555	27331.99365

Table 9

Scenario A: No supply constraints on primary factors

INITIAL OUTPUT LEVELS/SECTORAL GROWTH RATES

PERIOD	1	2	3	4	5	6
SECTORS						
STAPLE FOOD	0.0	39.7520	25.3440	35.1134	22.5544	11.4769
NON-STAPLE FOOD	0.0	12.8592	38.6384	52.2911	31.9248	9.3555
COTTON	0.0	13.6728	28.6202	28.1104	23.0915	9.3335
OTHER AGRICULTURE	0.0	18.1461	40.5101	48.7082	30.0886	9.5983
FOOD PROCESSING & INDUSTRY	0.0	11.2107	37.9284	56.3001	31.3607	6.9167
TEXTILE INDUSTRY	0.0	11.5858	44.3974	56.7888	39.6102	4.1194
OTHER INDUSTRIES	0.0	30.0172	34.4795	24.9870	18.2692	-26.7850
CONSTRUCTION	0.0	123.6372	69.2182	-2.5000	-36.6083	22.7624
CRUDE OIL & PRODUCTS	0.0	24.9660	31.1116	32.0984	16.8245	-0.5593
TRANSPORTS & COMMUNICATION	0.0	12.5733	35.1677	55.8973	36.1366	9.6685
HOUSING	0.0	9.6224	52.8782	85.0299	46.7482	7.2274
OTHER SERVICES	0.0	30.6900	37.4717	25.9338	13.4860	11.5295

unrealistic indicating a kind of "fine tuning" that would in practice be difficult to achieve.

Nearly all the growth characteristics are interrelated in a model solution just as they are in a real economy. Since, in this solution, it is assumed that all the labor and land are available to the economy that is demanded, these primary factors never constrain growth and other limitations come into play. Foreign exchange availabilities become constraining only after domestic capital capacity bottlenecks are broken. In another parlance, the domestic savings gap is binding in the first part of the plan period and then the foreign exchange gap becomes binding. This aspect of the results also reflects the exogenously set targets and other conditions. The exports of all exporting sectors are required to grow at 4 percent per year. Foreign capital inflows grow at 10 percent per year until the third, three year period when the growth rate falls to 6 and then, later, to 4 percent per annum. If the export growth rate had been allowed to be somewhat lower, expecially in the sectors in which the capital constraint was most restrictive, that would have freed resources for domestic capital formation and improved overall performance. This strategy would have worked up to the point at which the foreign exchange constraint became more restrictive. The composition of exports, specified exogenously, is shown in Table 11, and the composition of imports, determined endogenously, is presented in Table 12.

The purpose of working through this scenario has been to determine a growth pattern under conditions such that the availability of primary resources would not be a binding constraint. The amounts of such resources which would be required under such circumstances has been calculated and other features of the scenario presented. The primary resources necessary

It is interesting to note that, in spite of some potential for substitution of foreign for domestic production in each of the agricultural sectors, the relative proportions of land use among the various sectors changes only slightly. The appearance of stability in agricultural patterns is misleading, however, as can be seen from Table 8, which contains the gross output levels achieved over the plan period, and Table 9 which presents the implicit sectoral growth rates for each three year period. Table 10 contains the average annual growth rates within the plan period for the four agricultural sectors. With the exception of the cotton sector whose growth is determined mainly by the exogenously specified export demand, the average growth rates of the other sectors are rather similar. The growth rate differences reflect both the differences in the income elasticities of the various sectors and the scope provided for substitution of domestic by foreign supplies.

TABLE 10

Average Annual Growth Rates Within Plan Period (in percent)

Solution A - No Primary Factor Constraints

Staple Food	8.1
Non-Staple Food	8.5
Cotton	6.3
Other Agriculture	8.7

This relative stability contrasts with the period to period variability in sectoral growth performance shown in Table 9. The variability is the result of the shifts dictated by the optimizing mechanism as it exploits small differences among sectors in domestic resource and import requirements and in import opportunities to seek out the best possible growth patterns. These variations in growth rates are probably somewhat

Table 11

Scenario A: No supply constraints on primary factors

FOREIGN TRADE SECTOR

EXPORTS

PERIOD	1	2	3	4	5	6
SECTORS						
STAPLE FOOD	327.0000	367.8305	413.7356	465.3697	523.4478	588.7739
NON-STAPLE FOOD	159.0000	178.8534	201.1743	226.2807	254.5205	286.2846
COTTON	465.0000	523.0618	588.3398	661.7644	744.3524	837.2474
OTHER AGRICULTURE	48.0000	53.9935	60.7319	68.3112	76.8364	86.4256
FOOD PROCESSING & INDUSTRY	78.0000	67.7394	98.6893	111.0056	124.8591	140.4415
TEXTILE INDUSTRY	327.0000	367.8305	413.7356	465.3697	523.4478	588.7739
OTHER INDUSTRIES	267.0000	300.3387	337.8209	379.9808	427.4023	480.7420
CONSTRUCTION	0.0	0.0	0.0	0.0	0.0	0.0
CRUDE OIL & PRODUCTS	447.0000	502.8142	565.5653	636.1477	715.5387	804.8378
TRANSPORTS & COMMUNICATION	516.0000	580.4298	652.8673	734.3449	825.9910	929.0744
HOUSING	0.0	0.0	0.0	0.0	0.0	0.0
OTHER SERVICES	513.0000	577.0552	649.0715	730.0755	821.1887	923.6728

Table 12

Scenario A: No supply constraints on primary factors

FOREIGN TRADE SECTOR

IMPORTS

PERIOD	1		2		3		4		5		6	
TYPE	COMP.	NCOMP.	COMP.	NCOMP.	COMP.	NCOMP.	COMP.	NCOMP.	COMP.	NCOMP.	COMP.	NCOMP.
SECTORS												
STAPLE FOOD	26.	53.	37.	74.	46.	93.	0.	125.	0.	153.	0.	171.
NON-STAPLE FOOD	88.	177.	100.	199.	0.	276.	0.	421.	0.	555.	0.	607.
COTTON	33.	40.	38.	45.	0.	58.	0.	74.	0.	92.	0.	100.
OTHER AGRICULTURE	34.	67.	40.	80.	0.	112.	0.	166.	0.	216.	0.	237.
FOOD PROCESSING & INDUSTRY	574.	1147.	638.	1275.	443.	1759.	0.	2750.	0.	3612.	0.	3862.
TEXTILE INDUSTRY	67.	135.	75.	150.	0.	217.	0.	340.	0.	475.	0.	494.
OTHER INDUSTRIES	826.	1291.	1074.	1679.	1445.	2257.	1019.	2821.	111.	3337.	1564.	2443.
CONSTRUCTION	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CRUDE OIL & PRODUCTS	97.	194.	121.	242.	159.	317.	0.	419.	0.	490.	243.	487.
TRANSPORTS & COMMUNICATION	0.	162.	0.	183.	0.	247.	0.	385.	0.	525.	0.	575.
HOUSING	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
OTHER SERVICES	0.	288.	0.	376.	0.	517.	0.	651.	0.	739.	0.	824.
CAPITAL INFLOW	5891.0000		3323.0000		4186.0200		4985.6000		5608.1200		6281.0900	

under these conditions exceed by far any reasonable expectations, but ways in which the actual bottlenecks might be broken can be suggested. However, it will be useful to examine the implications of growth under more reasonable specifications of factor resource availabilities.

2. Scenario B: With primary factor as well as capital and foreign exchange supply constraints exist

Limitations on the availability of primary factors are always present, so the solution to be presented is more "realistic" than the previous one. However, it should not be interpreted as a projection of what will actually occur. It contains other constraints which might not, in fact, be present and does not permit adjustments which might well be expected to be made if some of the other conditions which are imposed actually exist in the future. The qualifications which should be kept in mind will be pointed out as the results are presented. In this example, the labor force starts from "realistic" levels and is assumed to grow at an annual rate of 2.5% per year. This might be slightly higher than the best-or more hopeful-projection, particularly for the later years when it might be more reasonable to expect a decline in population and labor force growth. But, as will be seen, modest changes in the labor force growth rate would have no effect on the outcomes.

The land endowment provided also starts from "realistic" levels and, in this instance, is assumed to grow at rates which start at 5%, decline to 3.6% and then remain constant at 3%. This represents a rather optimistic view of what can and will be done through expansion of multiple cropping, land reclamation and desert land conversion. Land availabilities do make a difference in this solution, so the optimism is "embodied" in the results obtained. The exogenously specified initial "endowments" of capital stocks, the required consumption growth rates and export levels are all the same as in the previous solution and the levels of foreign economic assistance provided are also the same. The previous solution demonstrated that the current range of projections of future economic growth in official Egyptian plans were not consistent with plausible projections of future availabilities of primary factors, if present import and export patterns were also maintained. This solution will help in determining which of the primary factors will be limiting under these conditions.

The national income accounts generated by this solution are shown in Table 13. As might be expected there is much less growth than in the previous case. The average annual real GNP growth rate starts at 3.8 percent, declines only gradually for three periods and then falls more sharply to only 1.8 percent at the end of the entire plan period.

The pattern of investment in this case is shown in Table 14. The irregular pattern of investment from year to year is the result of the unfettered flexibility which exists in the model and the cleverness of the optimization process in seeking out every advantage from shifts in resource use.

The total investment over the plan period and the proportions are also shown in Table 14 in order to indicate the overall investment strategy. The similarities to the investment pattern in the previous solution, in spite of the vastly different levels of investment and output are, perhaps, the most surprising result. Except for the much larger proportion of investment in staple food, the proportions of total investment in the other agricultural sectors, the food-precessing textile and transport industries are about the same. The lack of investment in construction indicates that the existing capacity could accommodate the new demands

Table 13

Scenario B: Labor and Land Availabilities As Well As Initial Capital Stock Constrained

National Income Accounts

PERIOD	1	2	3	4	5	6
SECTORS						
PRIVATE CONSUMPTION	12891.7091	13882.9524	14949.1680	16097.2694	17333.5454	18664.7675
INVENTORIES CHANGE	417.4167	183.2578	356.0665	439.1356	84.2540	0.0
FIXED INVESTMENT	3116.2390	2587.8137	3613.4042	3238.6874	2219.6988	0.0
TOTAL INVESTMENTS	3533.6557	2771.0715	3969.4707	3677.8230	2303.9528	0.0
GOVERNMENT EXPENDITURES	5208.0000	6202.8113	7387.5481	8798.5697	10479.0963	12430.6035
EXPORTS	3147.0000	3539.9470	3981.7314	4478.6504	5037.5848	5666.2740
IMPORTS	4806.1843	4317.5882	5647.3537	5846.5736	6636.8519	7248.0166
GNP	19738.1302	22087.2026	24621.0579	27194.0651	29132.5822	30727.5253
AGGREGATE CONSUMPTION/GNP	0.9170	0.9094	0.9072	0.9155	0.9547	1.0136
DOMESTIC SAVING	6846.4211	8204.2502	9671.8899	11096.7957	11799.0368	12062.7577
DOMESTIC SAVING/GNP	0.3469	0.3714	0.3928	0.4081	0.4050	0.3926
INVESTMENT/GNP	0.1790	0.1255	0.1612	0.1352	0.0791	0.0

Table 14

Scenario B: Labor and Land Availabilities As Well As Initial Capital Stock Constrained

INVESTMENT BY DESTINATION

Period	1	2	3	4	5	Total Investment Amount	Total Investment Percent
Receiving Sectors							
Staple Food	731.7939	0.0	79.8827	388.5672	11.6984	1211.94	8.2
Non-Staple Food	278.8929	973.4312	0.0	816.5670	0.0	2068.89	14.0
Cotton	84.7436	0.0	66.9075	66.1772	204.9979	423.00	2.9
Other Agriculture	579.1669	0.0	145.7929	0.0	0.0	724.97	4.9
Food Processing & Industry	234.6343	0.0	0.0	166.2244	344.9971	745.84	5.0
Textile Industry	113.0303	0.0	0.0	680.9874	0.0	794.02	5.4
Other Industries	488.7728	0.0	1747.7168	0.0	0.0	2236.49	15.1
Construction	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Crude Oil & Products	271.7438	248.2876	333.4768	809.0479	0.0	1662.56	11.3
Transports & Communication	142.9461	190.4334	1239.6275	0.0	0.0	1573.01	10.6
Housing	100.6254	621.8300	0.0	0.0	751.4560	1473.92	10.0
Other Services	89.8890	553.8316	0.0	311.1164	906.5493	1861.39	12.6

placed on it. This is because overall expansion is so limited due to land constraints. The differences in the share of the other sectors reflects in part the growing exogenous demands which have to be met and which require new investment.

Because of the irregular pattern of capacity creation in the various sectors, there is also an irregular pattern of capacity utilization as shown in Table 15. In the last period because growth is stifled by the great scarcity of land, there is excess capacity in all sectors. It will be noted that the capacity in the construction sector, which received no new investment, is fully utilized until the last period. There are some anomalies in the various sectors in that new capacity may be created in excess of that needed. The explanation is that it apparently makes no difference whether more or less capacity is created and there is no reason to create just exactly the amount needed. In effect, there are a number of different solutions - with varying amounts of capacity in some of the sectors - all of which will generate the same consumption totals. Those are constrained primarily by land limitations. The capital forming sectors, with the exception of non-staple food, use no land and that one sector contributes only to capital formation in agricultural sectors.

The rate of growth of consumption is always at the minimum required rate of 2.5 percent per year. In fact, it is this requirement which is, for all except the last years of the entire plan period, the most binding constraint and which, to a considerable extent, determines the pattern of the results. The land availabilities are just enough to sustain the required consumption growth but the overall growth generated is not enough to utilize all the labor, or even all the foreign exchange which is provided. By the very end of the plan period the land constraint becomes very tight and overall growth must be reduced in order to achieve the required

Table 15

Scenario B: Labor and Land Availabilities As Well As Initial Capital Stock Constrained

FACTOR AVAILABILITIES & USAGE

CAPITAL STOCK

PERIOD	1		2		3		4		5		6	
TYPE	STOCK	SLACK	STOCK	SLACK	STOCK	SLACK	STOCK	SLACK	STOCK	SLACK	STOCK	SLACK
SECTORS												
STAPLE FOOD	720.	0.	1437.	494.	1401.	354.	1446.	283.	1798.	517.	1765.	347.
NON-STAPLE FOOD	2117.	14.	2343.	0.	3258.	772.	3176.	534.	3914.	1072.	3816.	751.
COTTON	374.	0.	449.	53.	438.	0.	494.	0.	548.	0.	739.	145.
OTHER AGRICULTURE	765.	0.	1326.	530.	1292.	414.	1406.	469.	1371.	362.	1337.	242.
FOOD PROCESSING & INDUSTRY	913.	78.	1125.	126.	1097.	0.	1069.	3.	1209.	0.	1574.	276.
TEXTILE INDUSTRY	797.	0.	890.	24.	867.	235.	846.	121.	1506.	774.	1468.	667.
OTHER INDUSTRIES	5554.	971.	5904.	624.	5756.	0.	7360.	473.	7176.	1984.	6997.	1743.
CONSTRUCTION	309.	0.	311.	0.	303.	0.	295.	0.	288.	1.	281.	51.
CRUDE OIL & PRODUCTS	1516.	0.	1750.	0.	1955.	0.	2239.	0.	2992.	0.	2918.	529.
TRANSPORTS & COMMUNICATION	1275.	27.	1386.	0.	1542.	0.	2743.	1026.	2674.	761.	2607.	473.
HOUSING	1731.	100.	1791.	0.	2368.	459.	2309.	244.	2252.	0.	2947.	534.
OTHER SERVICES	1718.	128.	1765.	0.	2275.	285.	2218.	0.	2474.	0.	3318.	602.

consumption growth. All this is demonstrated by the patterns of shadow prices shown in Table 16. They are zero or only slightly positive on all the constraints except the consumption growth constraint until the last period when the shadow price on land becomes enormous. Essentially the solution adjusts to the imposed conditions of land limitations and only a modest growth performance is possible.

The shadow prices on capital are so small that they are not indicated even when capital is fully utilized. The same is true of the shadow prices on land during the middle of the plan period. As shown in Table 17, land acreage is fully utilized in periods 2,3,4 and 5. Similarly the shadow prices of foreign exchange. It can be seen in Table 18 that the labor force is not fully utilized in this solution. This results from the real limitation of land as well as from the exogenous stipulation of exports which, therefore, does not permit a greater concentration of resources in exporting industries. In actuality it would be expected that, if the export sector were not allowed to grow or did not respond to incentives to export, the "unemployed" labor would remain "hidden" in the agricultural sector and in urban service sectors.

With some reinterpretation this solution can shed some light on reality . Land is and has been fully utilized in Egypt and, therefore, a real constraint. Until recently at least labor has not, in an overall sense, been a limiting factor. Foreign exchange was a tightly binding constraint until the mid-1970's. When foreign exchange was quite constraining, given the limited export earnings of the economy and the diversion of a large portion of export earnings to military purchases, there was little real growth potential in the economy. Since the mid-1970's, with large increases

Table 16

Scenario B: Labor and Land Availabilities As Well As Initial Capital Stock Constrained

Shadow Prices on Constraints

Period	1	2	3	4	5	6
Shadow Price on Consumption growth Constraint	0	.92860	1.56009	1.97303	2.22615	2.36328
Shadow Price on Labor	0	0	0	0	0	0
Shadow Price on Land	0	0	0	0	0	5358.12132
Shadow Price on Foreign Exchange	0	0	0	0	0	0

Table 17

Scenario B: Labor and Land Availabilities As Well As Initial Capital Stock Constrained

FACTOR AVAILABILITIES & USAGE

LAND

PERIOD	1	2	3	4	5	6
SECTORS						
STAPLE FOOD	5.3796	7.0502	7.9742	8.8568	9.7564	10.7971
NON-STAPLE FOOD	2.6186	2.9177	3.1550	3.3543	3.6061	3.8898
COTTON	1.2972	1.3739	1.5492	1.7473	1.9377	2.1001
OTHER AGRICULTURE	3.5190	3.6583	4.0416	4.3116	4.6398	5.0330
TOTAL USAGE	12.8144	15.0000	16.7200	18.2700	19.9400	21.8200
FALLOW LAND	0.1856	0.0	0.0	0.0	0.0	0.0

Table 18

Scenario B: Labor and Land Availabilities As Well As Initial Capital Stock Constrained

FACTOR AVAILABILITIES & USAGE

LABOUR AVAILABILITIES
& UNEMPLOYMENT

PERIOD	1	2	3	4	5	6
SECTORS						
STAPLE FOOD	0.7512	0.9845	1.1136	1.2368	1.3624	1.5078
NON-STAPLE FOOD	2.0076	2.2369	2.4188	2.5716	2.7646	2.9822
COTTON	0.4815	0.5100	0.5751	0.6486	0.7193	0.7795
OTHER AGRICULTURE	1.1521	1.1977	1.3232	1.4116	1.5190	1.6478
FOOD PROCESSING & INDUSTRY	0.5557	0.6641	0.7294	0.7089	0.8039	0.8295
TEXTILE INDUSTRY	0.4142	0.4499	0.4930	0.5654	0.5709	0.6249
OTHER INDUSTRIES	0.1344	0.1548	0.1840	0.2202	0.1660	0.1680
CONSTRUCTION	0.4177	0.4204	0.4099	0.3997	0.3887	0.3110
CRUDE OIL & PRODUCTS	0.0164	0.0190	0.0212	0.0243	0.0324	0.0259
TRANSPORTS & COMMUNICATION	0.4527	0.5027	0.5592	0.6228	0.6941	0.7742
HOUSING	0.1641	0.1802	0.1921	0.2078	0.2265	0.2427
OTHER SERVICES	3.1996	3.5514	4.0039	4.4625	4.9769	5.4655
TOTAL EMPLOYMENT	9.7224	10.8435	11.9922	13.0479	14.1890	15.3207
UNEMPLOYMENT	2.2676	2.0785	1.9278	1.9421	1.9510	2.0593

in economic assistance, foreign borrowing, remittances, Suez Canal earnings and growing oil and tourist revenues, the foreign exchange constraint has been substantially relaxed. There has, in reality, also been more substitution of foreign consumption goods, intermediates and investment goods, than was permitted for this model solution. The additional foreign exchange has been utilized to support large increases in both consumption and investment. Part of the supply for the new demands has come from domestic production utilizing large amounts of imported intermediates. While all of this has permitted the economy to free itself from the tight embrace of the pressing land constraints, the adjustment process to the new demands on domestic agriculture has been partly responsible for raising agricultural prices. However, the pace of those price increases and other institutional factors, have not raised agricultural incomes enough to maintain the agricultural labor force. That has been drawn away by the temptations of higher wages and increased employment opportunities in urban areas due in part to the expanded production utilizing the increased amounts of foreign exchange available. The migration of Egyptian labor to the other Arab oil-exporting countries has been another factor contributing to the loss of labor by the agricultural sector with further effects on agricultural prices.

3. Scenario C: Export promotion and import substitution

If the current supply of foreign exchange to Egypt, of which foreign capital inflows provide a major part would continue to grow at past rates, then presumably the current patterns of income and consumption growth could also be maintained. But such a continuation is neither plausible, nor in fact, expected. Certainly the foreign economic assistance will not be indefinitely maintained at current levels and is not expected to be substantially enlarged. Nor can foreign borrowing fully replace that assistance. Suez Canal and tourist earnings may continue to increase but not at the past rates which reflect major new adjustments on both the supply and demand sides. Remittances may have a permanent growth factor built in, but are subject to political disruptions. Oil revenues will continue to increase, if more reserves are found. Yet such hopes are not a reliable basis for making development policy. All this has been realized, at least to some extent, by Egyptian policy-makers who have followed a policy of increasing domestic productive capacity in anticipation of changes in the relative future availability of foreign exchange. Questions as to the relative emphasis which should be given to the various sectors in the future growth process have not yet been fully resolved. As will be demonstrated, the answers depend in part on the relative factor scarcities.

The solution to be presented next represents one of many policies of resource allocation which could be followed. As pointed out above, the usefulness of the models is in exploring alternatives and, thus, illuminating the available choices and their consequences. This becomes quite evident here. For this next solution several major changes have been made in the model specifications. First, the exports which were stipulated exogenously have been reduced in most of the sectors. A choice procedure was created, however, which permitted the optimizing process to expand exports in particular sectors, if that was desirable, given all the constraints and the goal of maximizing consumption over the plan period. It continues to be the case that exports plus the exogenously specified foreign capital inflows must equal imports. The change to endogenous determination of exports makes it possible, if it becomes desirable, for the agricultural sectors to switch out of exporting and to concentrate on the domestic market. That, in turn, may help to relieve the land constraint. On the other hand, expansion of exports from those sectors in which could profitably earn foreign exchange is now permitted, if desired by the optimizing process.

The second major change is not one of specification of relationships but a change in the parameters which determine the magnitude of those imports which are competitive with domestic production. These are increased in order to permit a greater degree of substitution of imports for domestic output, if the optimizing process finds that to be desirable. Again the motivation is to increase the extent to which the supply of the output of a domestic industry, which is constrained by limited supply of domestic factors, could be augmented from imports. This also contributes to the potential for rearrangement of the relative importance of the various productive sectors.

The initial endowments of capital stock are kept the same in this solution. The size of the labor force is reduced slightly for most of the plan period but the implied potential growth increased. The total amount of cropped land area is also reduced slightly, in the direction of somewhat greater plausibility. Thus, if anything, the supplies of the primary factors are somewhat more constraining than in the previous solution. The exogenously specified foreign capital inflows are maintained at their former levels.

With greater freedom in export and import patterns, overall performance improves dramatically as can be seen in Table 19, for the national income accounts, by comparison with Tables 1 and 13. The levels of consumption achieved are uniformly higher. The undiscounted sum of consumption over the entire plan period in this last solution is MLE 138,995 as compared to MLE 93, 817 in the previous solution and MLE 163,853 in Scenario A in which there are no primary factor constraints.

Table 19

Scenario C: Export Promotion and Import Substitution

NATIONAL INCOME ACCOUNTS

PERIOD	1	2	3	4	5	6
SECTORS						
PRIVATE CONSUMPTION	13222.7964	15639.6490	23027.6198	24796.1491	30003.1141	32307.3636
INVENTORIES CHANGE	367.9309	496.7933	205.6639	339.0308	237.3403	334.6957
FIXED INVESTMENT	3586.7427	5702.7032	2554.9365	4340.2424	2902.5574	3441.7099
TOTAL INVESTMENTS	3954.6736	6199.4965	2760.6004	4679.2732	3139.8977	3776.4055
GOVERNMENT EXPENDITURES	5208.0000	6202.8113	7387.5481	8798.5697	10479.0963	12480.6035
EXPORTS	3147.0000	3557.6852	4716.7278	5771.1491	7025.9276	8663.8951
IMPORTS	6028.3381	7036.4517	8906.3234	10665.7387	12797.9140	15324.2466
GNP	19523.6852	24563.1907	28958.0349	33343.6118	37814.6747	41853.0272
AGGREGATE CONSUMPTION/GNP	0.9440	0.8892	1.0503	1.0075	1.0705	1.0701
DOMESTIC SAVING	6300.8888	8923.5417	5930.4150	8547.4627	7811.5605	9545.6636
DOMESTIC SAVING/GNP	0.3227	0.3633	0.2048	0.2563	0.2066	0.2281
INVESTMENT/GNP	0.2026	0.2524	0.0953	0.1403	0.0830	0.0902

The gross national product starts at roughly the same levels and then grows substantially faster than in the previous solution. By the end of the plan period GNP in this last example, is 35 percent larger than in the previous scenario. The comparative growth rates of GNP are 5.2 percent and 3.0 percent. The average annual growth rate of consumption in this solution is 6.1 percent compared with 2.5 percent in the previous case. These results suggest that, even if a somewhat smaller amount of foreign capital inflows had been specified, it would nonetheless have been possible to project quite a respectable performance.

The better overall performance in this solution is both cause and effect of the two-thirds higher level of investment which is achieved, in this case as compared to the previous one. It is worth the reminder that this investment is endogenously determined.

In this solution different constraints are binding from period to period. Tables 20, 21, 22 and 23 present the capital stocks and their utilization, the shadow prices on capital and the shadow prices on other constraints. In the first period, it is the capital stock in the textile sector which is the tightest constraint. As will be seen, it is from this sector that exports are pushed out most vigorously. Subsequently, the labor constraint is most restrictive until the final period,when the land supply has the highest shadow price. Foreign exchange is always scarce, though never having the highest shadow price. This reflects the many other adjustments made so that the model economy can expand faster and utilize more foreign exchange efficiently. The positive shadow rentals on the competitive import constraints indicate that, if allowed, the optimization process would have moved even further in replacing domestic agricultural production with imports. Taking all the indications together, the motivation

Table 20

Scenario C: Export Promotion and Import Substitution

FACTOR AVAILABILITIES & USAGE

CAPITAL STOCK

PERIOD	1		2		3		4		5		6	
TYPE	STOCK	SLACK	STOCK	SLACK	STOCK	SLACK	STOCK	SLACK	STOCK	SLACK	STOCK	SLACK
SECTORS												
STAPLE FOOD	720.	126.	705.	0.	800.	68.	780.	0.	897.	0.	982.	0.
NON-STAPLE FOOD	2113.	72.	2143.	0.	2854.	175.	2805.	0.	3260.	0.	3709.	0.
COTTON	374.	18.	369.	0.	437.	44.	426.	0.	459.	0.	479.	0.
OTHER AGRICULTURE	765.	0.	746.	0.	908.	57.	886.	0.	1013.	0.	1398.	0.
FOOD PROCESSING & INDUSTRY	913.	117.	891.	0.	1212.	87.	1181.	0.	1502.	0.	1716.	0.
TEXTILE INDUSTRY	797.	0.	971.	0.	946.	29.	1171.	0.	1456.	0.	1671.	0.
OTHER INDUSTRIES	5554.	268.	6464.	0.	7075.	0.	6898.	0.	6725.	0.	6557.	0.
CONSTRUCTION	309.	0.	583.	0.	568.	322.	554.	81.	540.	188.	527.	162.
CRUDE OIL & PRODUCTS	1516.	433.	2333.	0.	3336.	22.	4353.	0.	4985.	0.	4861.	0.
TRANSPORTS & COMMUNICATION	1275.	0.	1541.	0.	2190.	0.	2427.	0.	2941.	0.	3247.	0.
HOUSING	1731.	37.	2124.	0.	3481.	0.	3775.	0.	4745.	0.	5092.	0.
OTHER SERVICES	1718.	104.	2079.	0.	2319.	0.	2772.	0.	3144.	0.	3540.	0.

Table 21

Scenario C: Export Promotion and Import Substitution

SHADOW RENTALS ON CAPITAL CONSTRAINTS

PERIOD	1	2	3	4	5	6
SECTORS						
STAPLE FOOD	.	.01739-	.	.21229-	.15214-	.28903
NON-STAPLE FOOD	.	.53298-	.	.24735-	.15403-	.28683
COTTON	.	.54431-	.	.25103-	.15566-	.28587
OTHER AGRICULTURE	.01307-	.01262-	.	.21325-	.15367-	.28436
FOOD PROCESSING & INDUSTRY	.	.16428-	.	.19318-	.12605-	.31329
TEXTILE INDUSTRY	17.01442-	1.30591-	.	.20079-	.12735-	.30052
OTHER INDUSTRIES	.	.16954-	.17198-	.14289-	.12227-	.17817
CONSTRUCTION	9.75082-	1.12639-	.	.	.	.
CRUDE OIL & PRODUCTS	.	.05306-	.	.14771-	.19752-	.22247
TRANSPORTS & COMMUNICATION	.99597-	.47590-	.00577-	.19664-	.11491-	.24433
HOUSING	.	1.07463-	.01823-	.24121-	.13661-	.19868
OTHER SERVICES	.	.63725-	.00851-	.20960-	.12120-	.23105

Table 22

Scenario C: Export Promotion and Import Substitution

Shadow Prices on Import Constraints

PERIOD	1	2	3	4	5	6
SECTORS						
STAPLE FOOD	0.02630	0.0	0.31448	0.16222	0.03513	0.13649
NON-STAPLE FOOD	0.0	0.23921	0.30379	0.17411	0.03440	0.0
COTTON	0.10267	0.26703	0.34948	0.17821	0.02750	0.00475
OTHER AGRICULTURE	0.0	0.0	0.36525	0.15565	0.01792	0.0
FOOD PROCESSING & INDUSTRY	0.01150	0.04216	0.11661	0.06370	0.0	0.0
TEXTILE INDUSTRY	7.59827	0.45465	0.04193	0.0	0.0	0.0
OTHER INDUSTRIES	0.00546	0.0	0.0	0.0	0.0	0.03129
CONSTRUCTION	0.0	0.0	0.0	0.0	0.0	0.0
CRUDE OIL & PRODUCTS	0.01080	0.0	0.0	0.0	0.0	0.0
TRANSPORTS & COMMUNICATION	0.0	0.0	0.0	0.0	0.0	0.0
HOUSING	0.0	0.0	0.0	0.0	0.0	0.0
OTHER SERVICES	0.0	0.0	0.0	0.0	0.0	0.0

Table 23

Scenario C: Export Promotion and Import Substitution

Shadow Prices on Consumption Growth Constraints

Period	1	2	3	4	5	6
Shadow Price	0.0	0.0	0.0	0.00875	0	0.04073

Shadow Price of Foreign Exchange Constraints

Period	1	2	3	4	5	6
Shadow Price	0.0078	0.45351	0.46646	0.36010	0.29396	0.32352

Shadow Wages For Labor

Period	1	2	3	4	5	6
Shadow Price	0.0	549.42209	1130.70183	548.47054	290.13311	44.05435

Shadow Rental on Land

Period	1	2	3	4	5	6
Shadow Price	0.0	0.0	0.0	0.0	0.0	54.28348

of this replacement is, for the most of the plan period, to free labor from agriculture to staff the industrial sectors. That is shown most clearly by the high shadow prices on labor. Imports of agricultural products also become a means of circumventing the land constraint and also permit the transfer of labor to the industrial sectors. Nonetheless, in the last period land scarcity is the most limiting condition as indicated by its highest shadow price.

It is, perhaps, most revealing to present next the export patterns over the plan period as shown in Table 24. In the first period, they were required to be the same as in the previous solution. The patterns after that period show the change induced by the adaptation to land and labor scarcities. Exports from all the agricultural sectors never rise above the exogenously specified minimum levels which, in the staple food sectors, are lower than the original levels. The same is true of the food processing industry. On the other hand, in order to help earn the required foreign exchange, textile exports grow rapidly, although somewhat unevenly; by the end of the plan period they are five times the level of the initial three years. The exports of the "other industries" sector also grow rapidly in the first half of the plan period before the output of this sector is redirected toward domestic uses. The exports of crude oil and products are fixed exogenously and required to grow at, average annual rates of 20, 25, 15, and 10 percent respectively. The importance of the expansion of the exports of this sector for overall growth is demonstrated dramatically by this and the other tables. Without its foreign exchange earnings, the fundamental labor and land constraints would be even more difficult. Exports of the Transport and Communications sector and the other services sector are also fixed exogenously and embody average annual rates of 4 percent.

The import side of the foreign trade developments is shown in Table 25. The allocation of competitive imports are particularly revealing because they are subject to endogenous determination by the optimization process. It is clear that to facilitate growth these imports are allocated in rapidly increasing volume to the agricultural sectors replacing much of the growth in agricultural output that would otherwise have been necessary. At the outset the competitive imports of these sectors were only 8.6 percent of total competitive imports. By the end of the plan period they get 32.1 percent of the total. The importance of competitive imports in all of the industrial sectors changes over the entire plan period tending first to rise and then to fall as the land constraint and the labor constraint in agriculture have the effect of directing more imports toward these latter sectors. As noted, the shadow prices on the constraints which limit imports indicate that even more import substitution for domestic agriculture, if it had been permitted, would have taken place.

Output grows in all sectors, but at uneven rates as indicated in Table 26. The agricultural sectors, which at the beginning of the plan period produced 21.6 percent of total output, by the end of the plan period were generating only 18.1 percent of the total. This reflects the increasing replacement of domestic production with imports to free labor and reduce the effect of the land constraint. This process would have gone even further if not constrained. The output of the textile sector grows rapidly and its share rises from 8.0 to 11.8 percent of total output bearing out the effects of the export push from this sector. The share of Other Industries in total output actually falls by the end of the plan period as the absolute

Table 25

Scenario C: Export Promotion and Import Substitution

FOREIGN TRADE SECTOR

IMPORTS

PERIOD	1		2		3		4		5		6	
TYPE	COMP.	NCOMP.	COMP.	NCOMP.	COMP.	NCOMP.	COMP.	NCOMP.	COMP.	NCOMP.	COMP.	NCOMP.
SECTORS												
STAPLE FOOD	112.	47.	94.	56.	282.	59.	375.	63.	518.	72.	661.	79.
NON-STAPLE FOOD	78.	179.	606.	188.	1030.	240.	1348.	251.	1881.	292.	1795.	332.
COTTON	34.	40.	70.	41.	114.	45.	164.	49.	221.	53.	276.	55.
OTHER AGRICULTURE	0.	76.	58.	74.	255.	84.	354.	88.	507.	100.	0.	139.
FOOD PROCESSING & INDUSTRY	796.	1112.	1113.	1243.	1687.	1570.	2067.	1649.	1890.	2096.	1640.	2395.
TEXTILE INDUSTRY	66.	141.	162.	172.	344.	244.	6.	311.	0.	387.	0.	444.
OTHER INDUSTRIES	792.	1257.	757.	1519.	0.	1812.	785.	1767.	1171.	1723.	2419.	1680.
CONSTRUCTION	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
CRUDE OIL & PRODUCTS'	716.	141.	0.	305.	0.	433.	0.	568.	283.	651.	1709.	635.
TRANSPORTS & COMMUNICATION	0.	168.	0.	203.	0.	289.	0.	320.	0.	388.	0.	428.
HOUSING	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
OTHER SERVICES	0.	291.	0.	375.	0.	419.	0.	500.	0.	568.	0.	639.
CAPITAL INFLOW	4496.0000		3323.0000		4186.0200		4985.6000		5608.1200		6281.0900	

Table 26

Scenario C: Export Promotion and Import Substitution

GROSS OUTPUT BY SECTOR (MILL LE)

PERIOD		1	2	3	4	5	6
SECTORS							
STAPLE FOOD	3.3	1119.91497	1330.86800	1408.40729	1500.65582	1725.32405	1887.99193
NON-STAPLE FOOD	11.7	3851.45746	4042.58926	5151.87262	5393.40619	6268.95630	7133.38608
COTTON	2.0	671.90784	696.61228	756.78734	819.51766	882.58455	921.04225
OTHER AGRICULTURE	[illegible]	1530.00000	1492.92000	1702.61732	1771.16487	2026.18556	2795.99974
FOOD PROCESSING & INDUSTRY	[illegible]	3982.20483	4453.10788	5623.31595	5906.24301	7507.94257	8578.11617
TEXTILE INDUSTRY	[illegible]	2654.99991	3235.69295	4589.09250	5857.03391	7281.15241	8353.98580
OTHER INDUSTRIES	[illegible]	3959.46875	4860.06970	5798.96664	5653.99259	5512.64289	5374.82672
CONSTRUCTION	[illegible]	1848.11976	3490.30995	1475.84814	2831.37207	2107.67524	2186.88412
CRUDE OIL & PRODUCTS	4.0	1305.22174	2810.53348	3993.19731	5244.21712	6006.35417	5856.19544
TRANSPORTS & COMMUNICATION	[illegible]	1902.98502	2299.60543	3268.83168	3623.00526	4389.95266	4846.08064
HOUSING	[illegible]	508.90422	637.73186	1045.42972	1133.62609	1424.81480	1529.25894
OTHER SERVICES	[illegible]	9667.45688	12447.10808	13885.16854	16598.33184	18826.87046	21198.93085

level of output declines in the last nine years. The share of the Crude Oil and Products sector rises dramatically. The changes in the remaining sectors are small.

The distribution of the employed labor force is shown in Table 27. In the first three years of the plan period 43.7 percent of employment was in the agricultural sectors and 11.5 percent in industry. By the end of the plan period, the distributions were 38.3 percent in agriculture and 14.2 percent in industry. The changes appear relatively modest but they are critical. The import substitution for domestic agriculture and the export promotion of domestic industry are required to break labor and land bottlenecks. This can be viewed as a process of transferring by labor from lower to higher productivity sectors and the supplementation of domestic agricultural produce with foreign imports.

III. CONCLUSIONS

It is necessary to affirm that growth in Egypt is feasible when there is despair over past stagnation and current immobilism in some major features of the economy. There are, of course, real obstacles which have to be overcome if growth is to be achieved. The scenarios described above highlight both these difficulties and the means of overcoming them.

The first example indicates the magnitude of the increases necessary in the primary factors if growth is to proceed via capital accumulation and if there were to be no adjustments in relative factor input proportions and major reorientations in the patterns of output and trade. These increases in land and labor are far too large to make this a plausible growth strategy, even if there were substantial technological change. Perhaps the most striking result from this solution is that not only is

Table 27

Scenario C: Export Promotion and Import Substitution

FACTOR AVAILABILITIES & USAGE

LABOUR AVAILABILITIES
& UNEMPLOYMENT

PERIODS	1	2	3	4	5	6
SECTORS						
STAPLE FOOD	0.6193	0.7360	0.7788	0.8299	0.9541	1.0441
NON-STAPLE FOOD	1.9488	2.0455	2.6068	2.7291	3.1721	3.6095
COTTON	0.4589	0.4758	0.5169	0.5597	0.6028	0.6291
OTHER AGRICULTURE	1.1521	1.1242	1.2821	1.3337	1.5257	2.1954
FOOD PROCESSING INDUSTRY	0.5296	0.5923	0.7479	0.7855	0.9986	1.1009
TEXTILE INDUSTRY	0.4142	0.5046	0.7159	0.9137	1.1359	1.3032
OTHER INDUSTRIES	0.1544	0.1995	0.2262	0.2205	0.2150	0.2096
CONSTRUCTION	0.4177	0.7888	0.3335	0.6399	0.4763	0.4942
CRUDE OIL & PRODUCTS	0.0117	0.0253	0.0359	0.0472	0.0541	0.0527
TRANSPORTS & COMMUNICATION	0.4624	0.5588	0.7943	0.8804	1.0668	1.1776
HOUSING	0.1705	0.2136	0.3502	0.3798	0.4773	0.5123
OTHER SERVICES	3.2483	4.1822	4.6654	5.5770	6.3258	7.1228
TOTAL EMPLOYMENT	9.5637	11.4100	13.0200	14.8600	16.9600	19.3500
UNEMPLOYMENT	0.4363	0.0	0.0	0.0	0.0	0.0

the very limited amount of land a constraint on Egyptian development, but, if growth is to proceed as rapidly as recent projections foresee, labor also becomes an imminent constraint.

The second scenario, with realistic conditions on the supply of land and an extrapolation of current patterns of production for domestic use and exports as well as imports, indicates that only relatively slow growth could be achieved under these circumstances. Without any substantial reorientation of important sectors in their domestic and foreign sales and sources of supply, the primary resource bottlenecks would hold overall growth to relatively low levels. The solution indicates that land would be more constraining than labor. The low growth can be interpreted as the price of failure to perceive the need for major reorientations in the economy.

Finally, the last scenario demonstrates that, with reorientation of some sectors toward export markets and substitution of imports especially for agricultural products, the constraining power of limited land and labor can be substantially reduced. The redirection of agricultural outputs from foreign to domestic uses not only reduces the general tightness due to limited land it also permits the release of labor to the industrial sectors. These sectors, in turn, can now shift more of their output into exports and make up for the reduced earnings from agricultural exports. The policies are an indirect means for relaxing the land constraint as compared to the policy of direct attempts to increase the land supply by reclaiming desert lands. The indirect approach frees the labor which is required in the industrial sector while the direct approach provides for the absorption of more labor into agriculture.

The structure of the model embodies some features which underestimate the obstacles to growth and lacks other features which will facilitate the required transformations. All the possible difficulties associated with "management" and market penetration are assumed away. The optimization process foresees and accomplishes the necessary redirections of resources, investment, and output growth with perfect foresight and efficiency. There are no problems in developing new markets. Expansion of output is absorbed in domestic and foreign markets at rates which, again, are both perfectly foreseen and costless. It is only necessary to state the assumptions boldly to appreciate their unreality.

However, there are no benefits from technological change included in the model structure. All growth comes from an increase in resource inputs; none from increased resource productivity. Yet, in fact, one would expect such increases. The new investment, implemented on a major scale, would undoubtedly carry new technologies which would increase productivity. That, in turn, would make all the resources constraints less binding, although in different degrees, and the adjustments required less profound.

In an indirect manner, therefore, the analysis emphasizes the need for effective management of the economy, at the level of the production unit, to use resources effectively and implement technological change. At the macro level, policies are required which will support efficient management and facilitate the necessary transformations.

The scenarios are only a few of many alternatives which can be examined with the model but they highlight essential issues and suggest the need for consideration of new emphases in Egyptian development policy. Further exploration of these issues with the model and with detailed microeconomic studies are necessary to give more detail to these insights.

FOOTNOTES

1. Comprehensive and insightful discussions of this as compared to other types of planning models are contained in Alan Manne (1974) and Lance Taylor (1975).

2. For examples of "almost consistent" models see Joel Bergsmann (1966) and Lance Taylor (1975).

3. It would be reasonable to expect that economic performance in the first plan year would be at higher levels than in the preplan year. Lacking detailed knowledge of sector capital formation, the model solution started from the 1976 base year.

4. See R.S. Eckaus, "Effects of Construction Labor on the Egyptian Economy," M.I.T. Department of Economics Working Paper, No. 265.

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APPENDIX

The algebraic structure of the models is presented below with a detailed explanation of each equation in terms of the assumptions underlying it and the construction of its coefficients appearing in the L.P. model. A listing of the definitions of the symbols is also provided.

I Algebraic Structure of the Model

Objective Function:

$$\text{Max } W = \sum_{i=1}^{T} \frac{C(t)}{(1+w)^{3t-3}} \quad , \quad w = .1 \ ,;$$

subject to the following constraints, in each case for t = 1 to 6,

(1) $C(t) > (1+\rho)^3 \, C(t-1) \qquad \rho = .025 \quad ;$

(2) $X(t) + M^c(t) \geq AX(t) + F(t)^D + G(t) + E(t) + J(t) + S(t) \quad ;$

(2') $M^c_i(t) = 0, \text{ for } i = 8, 10, 11, 12 \quad ;$

(3) $F(t) = \xi(t)\, C(t) + \psi(t)\, L(t) \quad ;$

(4) $G(t) = \overline{G(t)} \quad ;$

(4') $\overline{G(t+1)} = \overline{G(t)}\, (1+.06)^3 \quad ;$

(5) $E(t) = \overline{E(t)} \quad ;$

(5') $E(t=1) = \overline{E(t)}\, (1+.04)^3 \quad ;$

(6) $S(t) \geq .15\, D(t) \quad ;$

(6') $S_i(t) = 0, \text{ for } i = 10, 11, 12 \quad ;$

(7) $K(t) \geq H(t)\, X(t) \quad ;$

(7') $K(1) = \overline{K(1)} \quad ;$

(8) $(.975)\, K(t) + K(t) > K(t+1) \quad ;$

(9) $D(t)'\, B \leq J(t)' \quad ;$

(9') $J_i(t) \neq 0$, for sectors 2, 6, 7, 8 and 12 ;

(10) $M^{nc}(t) = m\, X(t)$;

(11) $\bar{e}'\, M^{c}(t) + \bar{e}\, M^{nc}(t) \leq N(t) + \bar{e}\, E(t)$;

(12) $L(t) \geq \lambda(t)\, X\, (t)$;

(13) $L(t)\ (1+.025)^3 = L(t+1)$;

(13') $L(1) = \overline{L(1)}$;

(14) $T(t) \geq \tau X(t)$;

(14') $T(1) = \overline{T(1)}$,

(14'') $T(t) = T(t-1)\ (1+.03)^3$;

II Notes

The objective function is the standard one of maximizing discounted consumption over the periods of the model. The single period in the model is of three years. This represents an average investment lag and was chosen to avoid consideration of a more detailed lag structure. The longest investment lag is most certainly longer than 3 years, although some lags are shorter. This may build some "optimism" into the results.

Equation 1 establishes a basic growth rate for aggregate consumption. This helps take care of the flip-flop behavior inherent in these models. The rate of 2.5% was chosen as a growth rate in line with population growth in equation (13).

Equations 2 and (2') are the standard material balance equations. The data for base year magnitudes for these and the preceding equation were taken from R.S. Eckaus et.al. (1979) and multiplied by three to accomodate the 3 year period in the present model.

Equation 3 is the consumption function whose original form is

$$\frac{C_i(t)}{L(t)} = \Phi_i \left[\frac{C(t)}{L(t)} \right]^{\varepsilon_i}$$

and is linearized with a tangential approximation.

Equations (4) through (5') are equations with exogenous specifications for government and export uses of output. Government expenditures are assumed to grow exogenously at 6% per year and exports at 4% per year also exogenously.

Equations (6) and (6') are the inventory accumulation equations. Inventory is assumed to be set at 15% of gross investment in each sector. There are no inventories in the transport and communications, housing or services sectors.

Equations (7) and (7') are the capital stock equations - the capital output coefficients in the diagonal matrix H are "educated guesses". Initial capital stock in equation (7') was derived by multiplying output levels in the S.A.M.Matrix in Eckaus et.al. (1979) by three and then multiplying them by H.

Equations (8) and (9) are accumulation equations. In (8) a 2.25% depreciation rate has been assumed. Equation (9) translates investment by origin (the J(t) vector) into investment by destination (the D(t) vector) through a transmission matrix B. The coefficients of B were also educated guesses. They allocate capital by the following rule: 10% from textiles, 10% from services, 40% from construction and 40% from other industries.

Equations (10) and (11) describe the requirements and use of imports and foreign exchange. (10) is the demand for non-competitive imports. The m diagonal matrix was calculated from the S.A.M. of Eckaus et.al.(1979) by dividing imports in it by output levels. (11) and (12) are the foreign exchange constraint both N(t) and E(t) are set exogenously.

Equations (12), (13), (13'), (14), (14') and (14'') are the labor and land constraints. The $\lambda(t)$ vector in (12) was calculated by dividing a labor force of 9.568 million between the 12 sectors we have according to proportions of value added. The resulting employment matrix was divided by output levels in S.A.M. Matrix of Eckaus et. al. (1979).

The labor force size was set at 9.568 with a growth rate of 2.5% per year. The assumption here is that population and labor force are the same.

Land was allocated by cropped acreage to the four agricultural sectors. The annual productivity coefficients were divided by 3. Growth in productivity and yield was assumed to increase on average by 3% per year.

APPENDIX 1

Symbols (*)

A = Input output coefficients matrix (12X12)

B = Transmission matrix (12X12)

C(t) = Aggregate consumption per period

D(t) = Investment by destination (12X1), i.e., new capital

$e = \begin{bmatrix} 1 \\ 1 \\ 1 \\ \vdots \\ 1 \end{bmatrix}$

E(t) = Exports (12X1)

F(t) = Consumption by sector (12X1)

G(t) = Government expenditures (12X1)

H(G) = Capital output vector (12X1)

J(t) = Investment by origin (12X1) with only 5 non zero entries

K(t) = Capital stock in period t (12X1)

L(t) = Labor

$M^c(t)$ = Competitive imports allowed in all sectors except 8, 10, 11, 12. (12X1).

$M^{nc}(t)$ = Non-competitive imports (12X1)

N(t) = Foreign capital

S(t) = Inventories (12X1)

T(t) = Land

X(t) = Gross output (12X1)

ζ = Land output coefficients arranged along the diagonal of a null matrix (12X12)

λ = Labor output coefficients arranged along the diagonal of a null matrix (12X12)

(*) Numbers in parentheses indicate the dimentions of the matrices and a prime denotes transpose.

The three scenarios mentioned in the text are distinguished, in terms of the equations of this appendix, in the following ways:

Scenario A: Equations (13) through (14'') were deleted from the model.

Scenario B: All the equations (1) through (14'') were included in the program. Growth rates of primary factors are set as explained in the main text.

Scenario C: Export levels by sector are endogenously determined. Consequently, model equation (5') is deleted from the model.

For a representation of the equations in a tableau form see an example in Eckaus and Parikh (1968).

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